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CHARACTERIZATION OF MATERIAL PROPERTIES AT HIGH STRAIN-RATES USING THE TAYLOR IMPACT TEST

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The Taylor impact test has been used for a number of years to provide estimates for the dynamic yield stress of ductile, isotropic materials. Initially, these estimates were accomplished from post-test measurements by means of one-dimensional mathematical theory [1]. Through the years this theory has been improved and revised to include a number of material properties. There are too many contributions to specifically mention here.

The direction that most contemporary thinking has taken is to employ a large scale computer analysis to include as many effects as possible [2]. There are obvious advantages to this. However, the one-dimensional models still offer researchers the ability to study the dominant features of the impact event. It is this direction that the authors have chosen.

In 1987, the authors [3] offered an alternative to the classical Taylor equation of motion for the undeformed section of the specimen.

The new equation included a relative velocity term which accounted for the mass loss across the rigid-plastic interface. Later, this equation was used as the basis for a theory which separated the analysis into two fairly distinct regimes [4]. The two regimes represent early time deformation close to the anvil face that is dominated by extremely high strain rate behavior of the specimen material. The second regime accounts for most of the event and is characterized by constant plastic wave speed relative to the anvil face. This phase of the deformation is carried out at a much lower average strain rate than the primary phase.

Based on some simplifying assumptions regarding the geometry of the mushrooming region, an elementary theory which estimates stress as a function of strain rate is devised. This theory is used to characterize the high strain rate behavior of several useful materials. To a large extent, uncertainties about the simplified mushroom geometry have been shown to have little influence on the results [5].

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